
United States Department of Agriculture

## Office of the Chief Information Officer
### Network Engineering Division

# Telecommunications Enterprise Network Design

## Physical Baseline Definition of USDA Data Networks
## Task I Report

November 7, 1997
**Revised June 9, 1998**

Sensitive Information

The section of this document with Agency specific information is considered sensitive. The nature of the information could pose a security risk if it were disclosed to unauthorized personnel. Please consider the sensitivity of this information before making copies and distributing this report.

## Executive Summary

The US Department of Agriculture, Office of the Chief Information Officer, Network Engineering Division, is responsible for designing and implementing the USDA Telecommunications Enterprise Network according to the Telecommunications Stabilization and Migration Plan. The Initial Telecommunications Enterprise Network Design Plan involves six distinct tasks, the first of which is a Physical Baseline Definition of the USDA Data Networks.

This represents the Task I Report for the Physical Baseline Definition, which seeks the identification of the existing equipment and its interconnection. The physical components of the existing network are discovered using the method of electronically polling network components and thereby retrieving hardware and software configuration data. The electronically discovered data is verified and complemented with Agency responses to direct inquiry.

Summary data is presented regarding the status of the electronic discovery process as well as the response status from direct inquiry. The discovery process has identified 921 routers thus far. A summary of the initial Physical Network Inventory is also included.

Along with this summary report, each Agency or Organization within USDA receives a detailed list of its equipment and telecommunication services thus far identified. The information is presented in a convenient format for additional Agency response. The results validate the methodology used for this phase of the project and provide a preliminary gap analysis. Recommendations and instructions are provided to assist Agency network representatives with correct component configuration to allow continuation of the comprehensive electronic network analysis.

# 1.0 Introduction

The USDA Initial Telecommunications Enterprise Network (TEN) Design Plan is divided into six distinct tasks:

- Physical Baseline Definition of the USDA Data Networks
- Network Level Traffic Study of the USDA Data Networks
- Comprehensive Baseline Analysis of USDA Data Networks
- Development of Network Capacity Design
- Application Level Traffic Study of the USDA Data Networks
- Development of Initial TEN Design

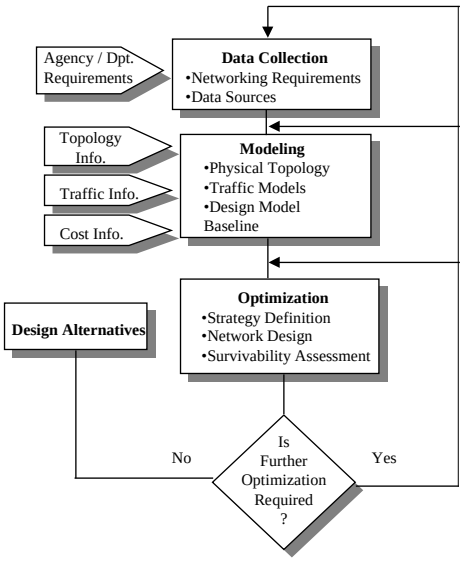


**Figure 1 Geographic Network Analysis Process**

A prerequisite to the development of the Initial TEN design is a complete and accurate description of the data networks existing throughout the USDA using a standardized evaluation process - the Geographic Network Analysis Design Process (GNAP) (Fig. 1). The first three tasks in the USDA Initial TEN Plan represent a data collection phase, the combined results of which describe the current state of the network – the Network Baseline. The Network Baseline is a dynamic model, updated as new information is derived or made available. The model represents a best available "snapshot" of the Network Baseline at any particular time prior to migration to the Initial TEN. At the conclusion of the data collection phase, despite the ongoing nature of the network baseline description process, the model represents necessary and sufficient information for the remainder of the Initial TEN design process.

This report addresses the first task of the data collection phase, the Physical Baseline Definition of the USDA Data Networks. The goal of the Physical Baseline Definition is a comprehensive descriptive inventory of physical elements of all USDA networks. Physical network elements comprise:

**Hardware Devices** - routers, LANs, frame relay points-of presence (POPs), and interfaces/circuit groups.

**Transmission Connections** - router to LAN, router to WAN, services (DTS, Frame Relay, ATM)

As a result of time constraints for inventory assessment and the need to provide accurate information, this report addresses only a subset of the network components. As additional information on the physical topology of the networks becomes available, the Physical Baseline Definition is updated accordingly.

Goals of this report are both to inform and learn. The information presented includes what is known, what is thought to be known, and what is not known about the existing USDA Network. By correcting the erroneous information and adding missing information, report recipients help improve the accuracy and completeness of the USDA Network description.

# 2.0 Methodology: Physical Baseline Data Collection

Two methods are used to collect data for construction of the networks Physical Baseline model: using electronic inquiry and using individual Agency information requests.

## 2.1 Discovery Process

The NetMaker XA® Simple Network Management Protocol (SNMP) Agent dynamically polls routers to obtain the information stored inside each router's Management Information Base (MIB). This information includes router configuration and connectivity. Router name, location, and circuit speeds are available if set properly in the router's configuration. Router connectivity gives the address of the neighboring routers that are subsequently polled. The tool automatically imports the data from every router it discovers. Discovery can thus be used to map either an entire internetwork or selected portions based on known network addressing. The discovery process attempts to retrieve all information necessary to build an accurate and thorough model of the network. The resulting data is available as reports, geographical maps, and files detailing attributes of the network components (e.g., router, LAN, WAN links).

### 2.2 Data Calls

A memorandum requesting information concerning Agency networks was sent to USDA Agency Senior Information Resources Management Officials from Hollace L. Twining - Senior Telecommunications Policy Advisor of the Office of the Chief Information Officer. The information requested includes data enabling the SNMP discovery of the respective Agency network by the NetMaker XA® modeling tool as well as an inventory of network equipment and associated attributes.

The information received from the Agencies is used to:

- Reconcile the information obtained by the electronic discovery process. For example, an incorrectly populated router MIB provides erroneous information, which is corrected by Agency input.
- Complement the discovery results. As an example, a router MIB not containing the physical address of the discovered device (NPANXX) can not have the node placed on the geographical map of the model.

## 3.0 Results

Initial results are presented in three parts. The response from the data call request for information is tabulated in section 3.1. Section 3.2 summarizes current knowledge regarding the physical network inventory. The addendum of this report details results of the respective Agency or Organization, and solicits assistance in completing the information.

### 3.1 Agencies / Organizations Response Summary

Table 1 summarizes the status of the discovery process for each network. Data are derived from the information received, as of June 5, 1998, from USDA Agencies and Organizations in response to the Information Request:

| Agency or Organization | Community String Response Received | Equipment List Response Received | Using FTS2000 Frame Relay or DTS | Network Connectivity Status | Discovery Status (# discovered/# known) |
|---|---|---|---|---|---|
| AMS | YES | YES | YES | Network is connected. Working on discovery/routing compatibility issues. | 556/61 |
| APHIS | YES | YES | YES | Network is connected. Working on discovery/routing compatibility issues. | 77/93 |
| ARS | YES | YES | YES | Networks connected to the USDA network with FTS2000 are reachable. Many ARS offices are co-located with Universities and are not connected to the USDA network. | 29/33 |
| CSREES | No Response | No Response | NO | Unknown – waiting for responses. | 1/— |
| ERS | YES | YES | NO | Network is connected. | 1/1 |
| FAS | YES | YES | NO | Network is connected. Working on discovery/routing compatibility issues. | 0/6 |
| FNS | YES | YES | YES | Network is connected. | 5/4 |
| FS | YES | YES | YES | Network is connected. Working on discovery/routing compatibility issues. | 475/430 |
| FSA | YES | YES | YES | Network is connected. Working on discovery/routing compatibility issues. | 20/35 |
| FSIS | YES | YES | YES | Network is connected. Working on discovery/routing compatibility issues. | 1/7 |
| GIPSA | YES | YES | YES | Network is connected. | 14/14 |
| LAN/WAN/ Voice | No Response | No Response | YES | Network is connected. | Not discovered. |
| NASS | YES | YES | YES | Network is connected. Working on discovery/routing compatibility issues. | 46/54 |

| Agency or Organization | Community String Response Received | Equipment List Response Received | Using FTS2000 Frame Relay or DTS | Network Connectivity Status | Discovery Status (# discovered/# known) |
|---|---|---|---|---|---|
| NRCS | YES | YES | YES | Network is connected. Working on discovery/routing compatibility issues. | 67/73 |
| OALJ | No Response | No Response | NO | Unknown – waiting for responses. | Not discovered. |
| OBPA | No Response | No Response | NO | Unknown – waiting for responses. | Not discovered |
| OC | No Response | No Response | NO | Unknown – waiting for responses. | Not discovered |
| OCE/WAOB | YES | YES | NO | Network is connected. | 1/1 |
| OCFO/NFC | YES | YES | YES | Network is connected – border router only. Security is in place for the rest of NFC. | 2/— |
| OCIO | YES | YES | YES | Network is connected. Working on discovery/routing compatibility issues. | 22/21 |
| OCIO/NITC | YES | YES | YES | Network is connected. Working on discovery/routing compatibility issues. | 3/6 |
| OGC | YES | YES | NO | No Wide Area Network. | Not Applicable |
| OIG | Currently Exempt | Currently Exempt | YES | Network is connected. Security is in place. | 1/— |
| OO | No Response | No Response | NO | Unknown – waiting for responses. | 2/— |
| OSDBU | No Response | No Response | NO | Unknown – waiting for responses. | Not discovered. |
| Other | | | | | 2/— |
| RHCDS (RD) | No Response | No Response | YES | Network is connected. | 79/— |
| RMA | YES | YES | YES | Network is connected. Working on discovery/routing compatibility issues. | 17/29 |
| RUS | No Response | No Response | NO | Unknown – waiting for responses. | Not discovered. |

**Table 1 Status of Network Discovery Procedure**

## 3.2 Initial Network Inventory Status

NetMaker XA® provides USDA with the capability to define the physical topology of the Department's network using the tool's Discovery process. The physical topology of USDA networks consists of:

- Network nodes including LANs, Frame Relay service Point-of-Presence(POP), and routers
- Transmission facilities interconnecting the network nodes. These include LAN connections, Wide Area Network (WAN) dedicated facilities such as Data Telecommunications Services (DTS), and Frame Relay Permanent Virtual Circuits (PVCs). Transmission facilities also include dial-up links.

The automatic Physical Network Baseline data collection process executed by NetMaker XA® relies on the information —Management Information Base — contained within each network node. The information base is complemented with information obtained from the Department's Agencies.

A node's information base provides not only information related to itself, such as the node's identification, manufacturer name, model number, and software information, but also the details on each of the interfaces associated with the node. The interface information includes its description (e.g. LAN/WAN), its type (e.g. Ethernet or FDDI or LAN, T1/56 Kbits/ Frame Relay access for WAN), the interface speed, and its far-end connection identifier (e.g. another node).
From this physical information database, a Physical Baseline topology of the USDA Networks can be modeled

The list below summarizes the initial inventory of USDA networks physical elements as of November 5, 1997.

| | |
|---|---|
| **Number of routers connected** | **921** |
| **Number of DTS WAN links** | **887** |
| **Number of Frame Relay POPs** | **395** |
| **Number of routers by Model Type** | |
| **3Com** | **3** |
| **Cisco** | **872** |
| **Wellfleet** | **5** |
| **Generic** | **41** |

| Number of WAN Links by type and speed [1] | |
|---|---|
| 0-64K | 225 |
| 65-128K | 61 |
| 129-256K | 52 |
| 385-512K | 17 |
| 513-768K | 35 |
| 769-1024K | 4 |
| 1025-1536K | 49 |
| T1 | 258 |
| E1 | 1 |
| Total | 702 |

**Table 2 Summary of USDA Network Physical Elements**

[1] The accuracy of the numbers for each link speed is questionable. Most routers use a default speed of 1.544Mbps (T1) if the configuration is either incomplete or inaccurate. The inordinately large number of T1 WAN links reflects the scope of the problem. See Section 5.0 "Interface Bandwidth Command" for a discussion of this issue.

The discovered nodes and links are depicted graphically in Figure 2. Figure 3 is another representation of the connectivity, the logical topology.

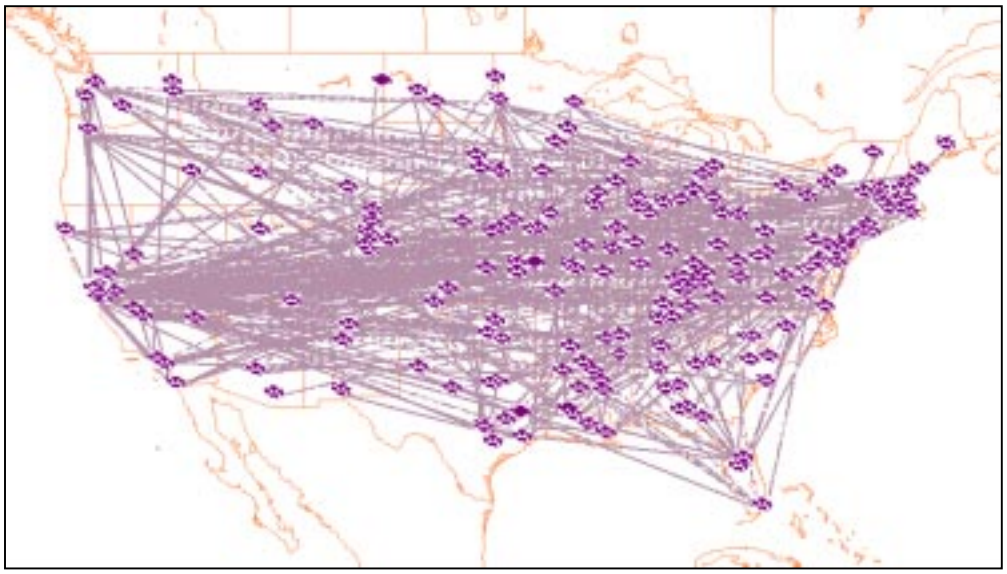

**Figure 2 Map of USDA Network based on geography. Data acquired with the netwoirk modeling tool used by the Network Design Team.**

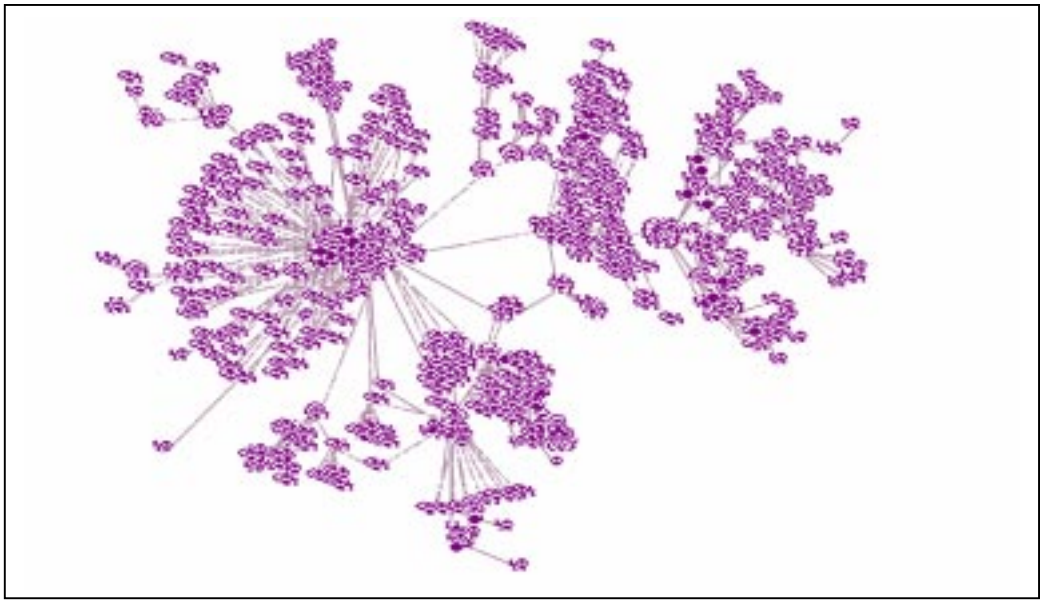

**Figure 3 A map of the USDA Network based on logical connectivity. Data acquired with the network modeling tool used by the Network Design Team.**

## 4.0 Conclusions

- The accuracy and completeness of the data presented in this report for the USDA as a whole is limited by the response to the data call reflected in section 3.1. However, the data presented for each individual Agency that responded to the data call provides a good description of physical elements for that Agency's portion of the USDA network. Sixty eight percent of the Agencies listed in section 3.1 have responded to the data call.
- The results presented in this report use the process described in section 2.0. The results validate the methodology chosen for the data collection phase of the project.
- As routers and other network devices are reprogrammed to contain accurate and complete SNMP configurations, the process will focus more on the electronic discovery process and less on the data call process. The goal is to eventually eliminate the need for data calls in this area. (Section 5.0 contains an SNMP configuration discussion.)

## 5.0 Discussion/Recommendations

The description of the USDA Network Physical Baseline is an ongoing process. As more information is derived through the electronic discovery process and through direct Agency response, the physical baseline model is more accurately and more completely defined.

Critical to the continuing description of the Network Baseline is information provided by the network functions of the individual agencies. By subscribing to the following recommendations, each Agency fulfills a key team role in the development of USDA telecommunications network.

**Verification of Report information:** The information provided in the addendum of this report represents the current description of the respective Agency telecommunications network. It is extremely important that time be allocated to check and make appropriate changes or additions to this information in the space that is provided. Electronic versions of this report can also be made available.

It is of particular importance to examine the line speeds reported on the router interfaces. This speed is used in the ongoing analysis of network utilization and cost. If a discrepancy is found, it must be corrected in the router's configuration. (See the discussion on the use of the "bandwidth" command in the following section.) Please note any discrepancy in the verification response, and also report when it is corrected in the router configuration.

Please send the completed verification or requests for electronic versions of the report by November 24,1997, to the Network Design Team at the address provided at the end of the section.

**Notification of network changes:** Both during the initial and the ongoing USDA Network description, it is extremely important for system efficiency and optimization that any changes to an Agency network be transmitted to the Network Design Team at the address provided at the end of the section. Changes that should be reported include router name changes, IP address changes, installation or removal of LANs, installation or removal of routers, and installation or removal of circuits or Frame Relay PVC's. This is necessary to produce an accurate and complete network design. Any network change information should be reported to the Network Design Team at the address provided at the end of this section.

**Simple Network Management Protocol (SNMP) configuration:** The electronic discovery component of the Network Physical Baseline description requires electronic access to each Agency's telecommunications equipment. To allow such access, all SNMP capable equipment with direct interface to wide area networks need a "Read

Only" community string. The community string is assigned by the organization responsible for managing the equipment. New community strings or changes in existing strings should be reported to the Network Design Team at the address provided at the end of this section.

In addition to the "Read Only" community string, access through firewalls, packet filters, and other security means must be provided for the devices used by the Network Design Team in the design process. For security reasons, the IP network addresses for these devices are not included in this document. To obtain the list of IP network addresses, contact the Network Design Team at the address provided at the end of the section.

The following set of router commands is the minimum set needed to fully implement the SNMP data collection portion of the process. The commands presented are for the Cisco Internetworking Operating System (IOS), which is the predominant router software on the USDA network. For non-Cisco IOS routers, the equivalent configuration for the device should be approximated.

*NOTE: If your organization cannot accomplish the configuration changes in a timely manner, the Network Design Team is available to make the changes. A list of routers and the appropriate passwords would need to be provided to the team. Requests for this service should be directed to the Network Design Team at the address provided at the end of this section. It is desirable to have all of these parameters available at the router, although at this time, we have not collected all of them for presentation to the Agencies.*

*Interface "bandwidth" Command:*

This command is used to set the SNMP variable used to determine the bandwidth of the circuit connected to each router interface. If this command is not used, the router reports the maximum bandwidth capability of the router interface hardware. For example, if a 56Kbps circuit is connected to a router interface that is capable of supporting a full T1, and the bandwidth command is missing, the circuit on the interface will be modeled as a full T1. This discrepancy will skew the circuit utilization and cost analysis. It is also important that interfaces on each end of a circuit have matching bandwidth values.

The following is an example of how to use the bandwidth command to set the circuit speed of a router interface to 56Kbps.

```
Interface Serial0
bandwidth 56          (Note: The bandwidth number is in Kbps, so do not
                            append trailing zeros)
```

*Interface Description Command:*

This command is used to document information about the connection to a router's interface. This information is classified into two categories, Wide Area Network (WAN) and Local Area Network (LAN) connections.

For WAN connections this information should include circuit type, service provider, circuit destination, and circuit identification number. The following format is recommended:

Interface Serial0
Description <Service Provider>, <Circuit Type>, <Destination>, <Circuit ID>
Where

Service Provider = AT&T, US West, Bell Atlantic, etc.
Circuit Type = DTS, Frame Relay, X.25 etc.
Destination = HQ - Washington DC, NITC - Kansas City MO, etc.
Circuit ID = Circuit ID provided by the service provider.

For Example:

Interface Ethernet0
Description Bell Atlantic, SMDS, HQ Washington DC, ABCD123456

Interface Serial0
Description AT&T, DTS, HQ - Washington DC, WXYZ123456
Interface Serial1
Description US West, Frame Relay, US West Switch, ABC123456

For LAN connections this information should clarify the purpose of each local connection. The following format is recommended:

Interface Ethernet0
Description <Description>

Where

Description = Description of the purpose of the local connection (i.e. – "General Office LAN", "Network management LAN", "Internet Server LAN")

For Example:

Interface Ethernet0
Description HQ Administrative Services LAN

Interface Ethernet1
Description Internet Server LAN

*Router "hostname" Command:*

This command is used to uniquely identify a router in the network. A standard naming convention will be developed and used as the Telecommunications Enterprise Network is implemented. Most routers already have this command in the configuration, and should not be changed without notifying the design team. If a router does not have this command or a new router is being deployed, contact the design team for guidance on establishing a name for the device. The syntax for the command is as follows:

Hostname <router name>

*SNMP Read Only Community String Command:*

This command is used to set the SNMP Read Only password for the router. There may be multiple occurrences of this command. One of the passwords should be reported to the design team. The password will give read-only access to the router, but will not permit changes to be made on the router. The syntax for the command is as follows:

snmp-server community <password> RO

*SNMP Location Command:*

This command is used to set the SNMP location variable. The variable is used to position the router on a map. The network modeling software requires the following format:

snmp-server location <NPANXX>, <Description>

Where

NPANXX = Six digit number = area code + local exchange.
Description = Physical Address of router (Street, City, State)

For Example:

snmp-server location 202720, 14th & Independence Ave, Washington, DC

*SNMP Contact Command:*

This command is used to identify who is responsible for managing the router. The syntax for the command is as follows:

snmp-server contact <Description>

Where

Description = Name (first last), phone number (xxx-xxx-xxxx), E-Mail (mail-id@domain), etc.

*SNMP Chassis-id Command:*

This command is used to identify the external serial number for a router (If this command is missing, the router reports the internal serial number of the CPU). The syntax for the command is as follows:

snmp-server chassis-id <number>

Where

number = Router's external Serial Number

**FOR HELP, CONTACT THE NETWORK DESIGN TEAM:**

Dan Crosson
OCIO Telecommunications Services, Network Engineering Division
2627 Redwing Road
Creekside 1, Second Floor
Fort Collins, CO 80526
E-Mail: dcrosson@usda.gov
Voice: (970) 282-1909
FAX: (970) 282-1999

# Addendum A – Router Hardware

This addendum provides detailed information on router hardware, including interface configuration. Any discrepancies or missing information should be provided to the Network design team as described in Section 5.0 of this document. The following should be noted:

- The interface information was taken from the router's SNMP MIB, and can be corrected through the router's configuration as described in Section 5.0 of this document.

- The "NPANXX" field is used to place the router on the geographic map. This determines how links to the router are priced, and how the router is connected during the design phase of the project.

- The "Line Speed" field must be set correctly, or the circuit's utilization and cost analysis is skewed.

- The "Destination (Router Name)" field contains the router name in the case of point-to-point circuits. When the interface is connected to a Frame Relay POP, the field contains a "P" with the router's name appended.

**Sensitive Information**
Disclosure of information in this section to unauthorized personnel could pose a security risk.

# Addendum B – Wide Area Network Links

This addendum provides detailed information on the wide area network links connected to router hardware. Any discrepancies or missing information should be provided to the Network design team as described in Section 5 of this document. The following should be noted:

- The order in which the end point nodes are presented was determined by an automated discovery process, and does not imply any hierarchical relationship.
- The "Node A" and "Node B" fields contain the router names of the link end points.
- In the case of Frame Relay access circuits, "Node B" will be designated as "Frame Relay POP".

The "Speed" field is determined the same as the "Line Speed" field in the interface section of the Router Hardware report. It can be corrected in the router's configuration as described in Section 5 of this document.

**Sensitive Information**
Disclosure of information in this section to unauthorized personnel could pose a security risk.

# Addendum C – Frame Relay Links

This addendum provides detailed information on the Frame Relay links, or Permanent Virtual Circuits (PVCs) associated with interfaces on router hardware. Any discrepancies or missing information should be provided to the Network design team as described in Section 5 of this document. The following should be noted:

- The order in which the end point nodes are presented was determined by an automated discovery process, and does not imply any hierarchical relationship.

- The "Node A" and "Node B" fields contain the router names of the Frame Relay link end points.

- The "Speed" field is calculated has one half of the reported speed for the associated router interface by the network discovery software. In cases where this calculation is incorrect, the corrected value should be reported to the Network Design Team.

**Sensitive Information**
Disclosure of information in this section to unauthorized personnel could pose a security risk.

# Addendum D – Routers Reported – Not Discovered

This addendum provides known information on router hardware that has been reported, but for various reasons has not been included in the automated discovery process. Any discrepancies or missing information should be provided to the Network design team as described in Section 5 of this document. The Network Design Team will continue to work on adding these devices to the list of discovered routers. The following should be noted:

- It should be verified that the routers identified in this report are configured as described in Section 5 of this document.

- The "NPANXX" field is used to place the router on the geographic map during the discovery process. This will determine how links to the router are priced, and how the router will be connected during the design phase of the project.

**Sensitive Information**
Disclosure of information in this section to unauthorized personnel could pose a security risk.